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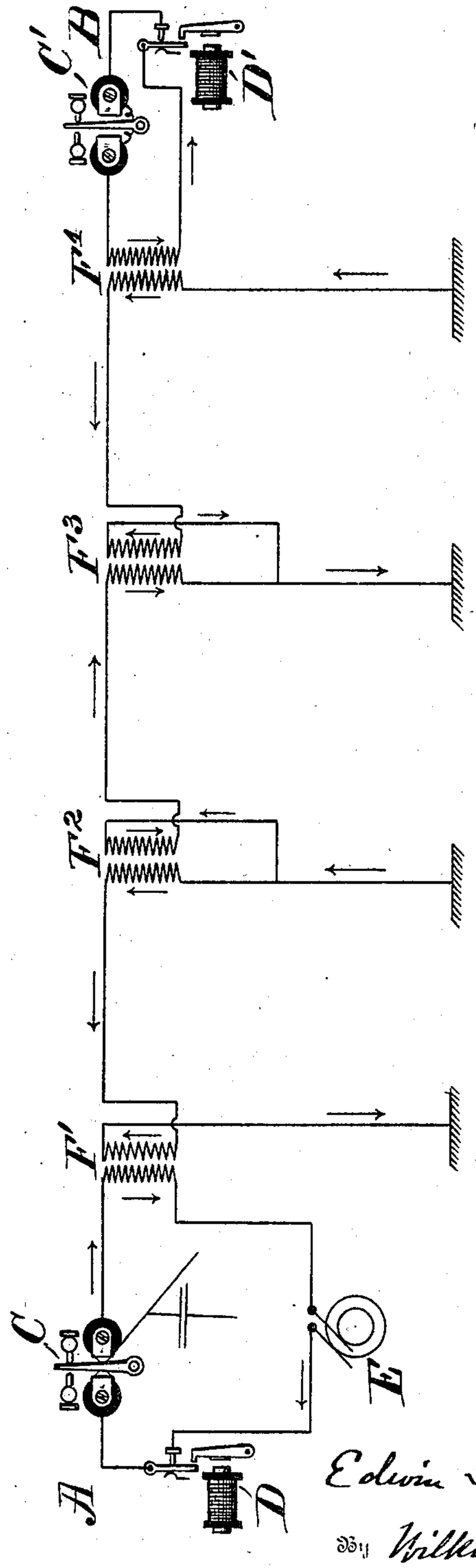
E. F. NORTHRUP.

ELECTRIC CIRCUIT.

APPLICATION FILED SEPT. 27, 1901.

NO MODEL.



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ELECTRIC CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 726,734, dated April 28, 1903.

Application filed September 27, 1901. Serial No. 76,776. (No model.)

To all whom it may concern:

Be it known that I, EDWIN F. NORTHRUP, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Electric Circuits; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in electric circuits, and more especially to telegraph or other circuits employing alternating or other periodically-varying electric currents for the transmission of intelligence; and the objects of my invention are, first, to prevent mutual magnetic induction between such circuits and neighboring lines; second, to prevent the flow of foreign direct currents from earth through the main-line instruments, and in general to isolate these instruments from outside disturbing currents. I accomplish the first of these objects by dividing the line to be protected, preferably where it lies in proximity to another line, into sections or subcircuits, in each of which at a given instant the current flows in the opposite direction to that in an adjacent section and in this way neutralizing the inductive effects of one section by those of an adjacent section. This is done by inserting in the line a series of transformers or their equivalents and connecting these in the manner hereinafter described and shown. By locating one of these transformers at each terminal station I am enabled also to operate the main-line instruments entirely disconnected from earth, notwithstanding the intermediate line is grounded, and in this manner to prevent the flow of foreign currents, such as trolley-currents, on to that part of the line in which said instruments are connected.

In order to more fully describe my said invention, reference will be had to the accompanying drawing, in which—

A and B represent terminal stations connected by a line constructed according to my invention.

C and C′ represent main-line receiving-relays; D and D′, transmitters; E, any source of alternating or other periodically-varying electric currents, preferably an alternating-current dynamo, and F′, F², F³, and F⁴ a series of transformers.

The special form of telegraph-line which I have selected for illustrating the principle of my invention is, with the exception of the transformer connections, fully described in the application of Henrietta H. Rowland, administratrix of Henry A. Rowland, for improvements in telegraphic distribution, filed July 24, 1901, and serially numbered 69,523, and designated therein a "reflected wave" line. The character of the line, however, whether reflected wave, duplex, or simplex forms no part of my invention, it being applicable to all.

In applying my invention to the form of line illustrated I preferably connect the terminals of the dynamo-circuit to the primary of a transformer F′ and connect one of the terminals of the secondary of this transformer to the main line and the other to earth. In this way the apparatus, such as the main-line receiving-relay connected in the dynamo-circuit, is as far as direct currents are concerned entirely disconnected from earth. The second section of the line comprises the secondary of transformer F′, the primary of transformer F², the line connecting the two, and the earth. Similarly the next section comprises the secondary of one of its terminal transformers, the primary of the other, the line connecting the two, and the earth, and the same holds true relative to all of the intermediate sections. There may be as many intermediate sections as desired and the transformers distributed at any desired intervals, though it is preferable that the sections outside of the terminal stations be of even number. The terminal transformer F⁴, however, has its primary only connected to earth, while its secondary furnishes the current for the local receiving apparatus and is entirely disconnected from earth, which, as in the case of the dynamo end of the line, places the apparatus located in its circuit beyond the disturbing influences of foreign direct currents which might otherwise pass on to the line. The connections of the secondaries are crossed, as shown, in order to produce the opposite flow of current in adjacent sections, as

the current in the primary of each transformer differs approximately one hundred and eighty degrees in phase from that in the secondary. The arrows indicate the directions of the currents at a given instant. It is, however, immaterial in which direction the current flows in the circuit at terminal station B. Hence the connections with the secondary of transformer F^4 may be made either direct, as shown, or crossed, as in the case of the transformers located along the line. Likewise it is immaterial whether the current in the line at station A flows in the same or opposite direction from that in the adjacent sections; but with the intermediate sections of the line this is material, since the non-mutual inductive character of the line is due to the neutralizing effects produced by the oppositely-flowing currents in the successive sections.

It is well known that the most obvious way of preventing mutual induction between lines is to employ a return-wire parallel to and near the first, in which case the currents induced on one wire would be neutralized by those resulting from the same induction on the other. This method, however, is of value only when the wires are near each other and equally near the disturbing wire. In contradistinction to this idea my invention does not contemplate the employment of a return-wire or any of the various devices which have hitherto been resorted to for the prevention of mutual induction; nor is my invention confined in its application to telegraph-lines alone, as the principle applies alike to all lines carrying alternating or other periodically-varying currents; but

What I do claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. An electric circuit for the prevention of mutual magnetic induction between the same and a neighboring conductor, comprising a plurality of sections in which current in one section flows in an opposite direction from that in an adjacent section, whereby the mutual magnetic effect on an adjacent conductor, of one section, is neutralized by that of an adjacent section, and a source of periodically-varying electric current connected to said circuit, substantially as described.

2. An electric circuit for the prevention of mutual magnetic induction between the same and a neighboring conductor, said circuit comprising a plurality of sections in which the current flow is opposite in adjacent sections, the mutual magnetic inductive effect of one section being neutralized by that of an adjacent section, transformers inducing the current from one section to the next and a source of alternating or other periodic electric current connected to said circuit, substantially as described.

3. An electric circuit for the prevention of mutual magnetic induction between the same and a neighboring conductor, said circuit comprising a series of transformers, a metallic conductor and ground, the primary of one transformer being connected to the secondary of the next adjacent transformer over said main line and the earth, by which the said circuit is divided into sections, the current flow in adjacent sections being in opposite directions, whereby the mutual magnetic inductive effect of one section on a neighboring conductor is neutralized by that of an adjacent section, and a source of alternating or other periodically-varying electric current connected to said circuit, substantially as described.

4. An electric circuit for the prevention of mutual magnetic induction between the same and a neighboring conductor, said circuit comprising a plurality of grounded intermediate circuits, transformers inducing currents from one circuit on to the next, and terminal circuits disconnected from earth and inductively connected to the intermediate sections.

5. An electric circuit for the transmission of intelligence and for the prevention of mutual magnetic induction between the same and a neighboring conductor, said circuit comprising local terminal circuits disconnected from earth, a series of grounded circuits located between the terminal circuits, and inductive means for impressing the current successively from one of said circuits on to the next.

6. An electric circuit for the transmission of intelligence and for the prevention of mutual magnetic induction between the same and a neighboring conductor, said circuit comprising local terminal circuits disconnected from earth, main-line apparatus located in said circuits, a grounded main-line circuit between the terminal circuits, and inductive means for impressing the current successively from one of said circuits on to the next.

7. An electric circuit carrying alternating or other periodically-varying currents for the transmission of intelligence, comprising local terminal circuits disconnected from earth, a grounded line-circuit, and transformers interposed between the terminal circuits and the main-line circuit by which currents are induced from one circuit on to the next.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN F. NORTHRUP.

Witnesses:
JOHN H. HOLT,
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